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SUMMARY: Admissions to hospital during the first year of life were recorded in a prospective study of 10,672 infants whose mothers' smoking habits were known. Infants with major congenital malformations, and those dying before their first birthday, were excluded. The infants of mothers who smoked had significantly more admissions for bronchitis or pneumonia, especially in the winter, and more injuries. They were also admitted more frequently, though not significantly so, for upper-respiratory-tract infections, gastroenteritis, childhood infectious diseases, and other diagnoses. The excess of bronchitis and pneumonia in the the group exposed to smoke increased with increasing number of cigarettes smoked by the mother. It occurred within subgroups of birth-weight, social class, and birth order. It was seen mainly in infants aged 6-9 months, while at older and younger ages there was no significant effect of maternal smoking. The findings support the hypothesis that atmospheric pollution with tobacco smoke endangers the health of non-smokers.

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INFANT ADMISSIONS TO HOSPITAL AND MATERNAL SMOKING

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Summary Admissions to hospital during the first year of life were recorded in a prospective study of 10,672 infants whose mothers' smoking habits were known. Infants with major congenital malformations, and those dying before their first birthday, were excluded. The infants of mothers who smoked had significantly more admissions for bronchitis or pneumonia, especially in the winter, and more injuries. They were also admitted more frequently, though not significantly, for upper respiratory tract infections, gastroenteritis, childhood infectious diseases, and other diagnoses. The excess of bronchitis and pneumonia in the group exposed to smoke increased with increasing number of cigarettes smoked by the mother. It occurred in all ethnic subgroups, in all social classes, and in all homes. It was seen mainly in infants aged 6-9 months, while at older and younger ages there was no significant effect of maternal smoking. The findings support the hypothesis that atmospheric pollution with tobacco smoke endangers the health of non-smokers.

Introduction

CIGARETTE smoking contaminates the atmosphere,¹ and in closed smoke-filled rooms, non-smokers passively inhale smoke components.² While non-smokers exposed to tobacco smoke may experience nose and eye irritation, cough, and headache,³ the relevance of these symptoms to objective measurements of health has not been established.

We have measured the frequency of hospital admissions in a population of West Jerusalem infants whose mothers' smoking habits were known, to test the hypothesis that passive smoking is associated with an increase risk of respiratory disease. In addition, smoking mothers and their infants might be exposed to more accidents since carbon monoxide and other constituents of tobacco smoke alter sensory and motor function.⁴ Furthermore, since smoke pollution in the home should be worse when windows are closed and ventilation reduced, any effect of smoking on morbidity should be greater in winter than in the summer.

In West Jerusalem, hospital inpatient data are a more sensitive index of infant morbidity than in other populations. Paediatrician-G.P. and hospital care are equally available to all, and the reluctance of paediatricians to visit homes added to the availability of hospital beds are associated with hospital-admission rates which are probably the highest in the world.⁴ 18% of liveborn infants are admitted at least once before their first birthday, some of them several times, so that the rate of admission episodes is over 25 per 100 liveborn.

Materials and Methods

We have made use of data collected in the record-linked Jerusalem Perinatal Study, described elsewhere.⁵ A file, stored on magnetic tape, has been opened for every infant born since 1964 to a mother who lives in West Jerusalem. The file contains information taken from birth certificates and labour-ward books, and is updated with data on deaths and malformations reported from multiple sources.

During 1965-69, all admissions to Jerusalem's three paediatric wards were recorded for infants born since the beginning of the study. The information added to the file included the dates of admission and discharge and the first three diagnoses recorded on the discharge summary, as well as events taking place in hospital and measurements of haemoglobin and weight.

In 1965-68, data from an antenatal interview were added to the file. 68% of pregnant women were interviewed, those attending certain municipal mother-and-child health clinics and hospital-based antenatal clinics. Most interviews were done from the fourth month of pregnancy onwards,⁶ and defined indices of health and behaviour were recorded, including details of smoking.

We divided the number of admission episodes to hospital during the first 365 days of life into the following diagnostic categories:

Bronchitis or pneumonia if either or both was among the first three diagnoses recorded on the hospital discharge summary (I.C.D. codes 480, 490-502, 518-529).

Upper-respiratory-tract infections without mention of bronchitis or pneumonia (31, 391-4, 470-9, 481, 510-7).

Gastroenteritis without mention of respiratory infections (40-9, 517-2, 764, 784.1, 785.6).

Other infections and inflammatory diseases, without mention of gastroenteritis or respiratory tract infections (1-39, 50, 52-139, 340-3, 370-9, 400-416, 468, 482-3, 531-2, 536-9, 575-7, 582-3, 590-3, 600, 605, 607, 609, 614, 617.0-2, 630, 690-9).

Injuries and poisoning regardless of other diagnoses (800-999).

All other diagnoses.

Results

There were 11,350 liveborn infants whose mothers had been interviewed in pregnancy. 678, who had major congenital malformations⁵ or died before their first birthday, were excluded, leaving a study population of 10,672. At the time of the interview, 9.2% of the mothers were smokers, and 7.4% had given up smoking earlier. For the total population studied, there were 25.4 admissions per 100 babies aged under 1 year.

The infants of smokers had significantly more admissions to hospital, 30.0% compared with 24.9% for those of non-smokers (table 1). They had higher rates of admissions for bronchitis or pneumonia

TABLE 1—ADMISSION-RATES (PER 100 INFANTS) BY DIAGNOSIS AND MATERNAL SMOKING CHARACTERISTICS

Diagnosis	Non-smokers (9686)	Smokers (986)	Total (10,672)
Bronchitis and pneumonia	9.5	13.1 (P<0.001)	9.8
Upper-respiratory-tract infections	4.8	5.3 (N.S.)	4.9
Gastroenteritis	6.4	6.5 (N.S.)	6.4
Other infectious diseases	1.1	1.2 (N.S.)	1.1
Injuries and poisoning	0.4	1.0 (P<0.01)	0.5
Other	2.9	3.1 (N.S.)	2.9
All	24.9	30.0 (P<0.001)	25.4

N.S. = Not significant.

TABLE II—ADMISSION-RATES (PER 100 INFANTS) BY DIAGNOSIS, MATERNAL SMOKING, AND NUMBER OF CIGARETTES SMOKED DAILY

Diagnosis	Non-smokers		Smokers			Total (10,672)
	Never smoked (8900)	Former smokers (786)	Cigarettes per day			
			1-10 (747)	11-20 (179)	21 + (60)	
Bronchitis and pneumonia....	9.6	7.8	10.8	14.2	31.7	9.8
All other.....	15.5	15.1	16.4	17.3	23.3	15.6
Total.....	25.1	22.9	27.2	33.5	55.0	25.4

Differences among three categories of smokers: for bronchitis and pneumonia, $p < 0.001$, for other diagnoses, not significant.

and more (13.1 per 100) than the infants of non-smokers (9.5 per 100) and more for injuries or poisoning (1.0 v. 0.4 per 100). They also had more upper-respiratory-tract infections, gastroenteritis, infectious and inflammatory diseases, and other diagnoses; though for each of these last four categories the differences between infants of smokers and non-smokers were not statistically significant. Infants born to smokers were in hospital for an average of 384 days per 100 infants before their first birthday, 151 of them for bronchitis or pneumonia. These rates were 334 and 114, respectively, for the infants of non-smokers. However, there were no significant differences between the groups, exposed or not exposed to smoke, in average duration of each type of admission episode.

Admissions for bronchitis or pneumonia increased in frequency with increasing number of cigarettes smoked by the mother (table II). There were no significant increases for any of the other diagnoses measured separately. Infants of mothers who had given up smoking had fewer admissions than those whose mothers had never smoked. This difference, which can be explained by the higher standard-of-living of those who gave up smoking, is not, however, statistically significant for any single diagnostic category. Infants born to former smokers spent fewer days in hospital in the first year of life (231 per 100 infants, 79 of them for bronchitis or pneumonia), and their admission episodes tended to be shorter for each diagnosis.

Women who smoke give birth to smaller infants,² and birth-weight is an important predictor of admission to hospital in West Jerusalem.⁴ Admissions for bronchitis or pneumonia are more frequent in infants who are smaller or larger than average at birth; while for other diagnoses, increasing birth-weight predicts a decreasing probability of going to hospital. Table III shows that the excess of admissions for bronchitis or pneumonia in the passively smoking infants could not be wholly attributed to lower birth-weights, rates being higher than in the infants of non-smokers for all three birth-weight groups.

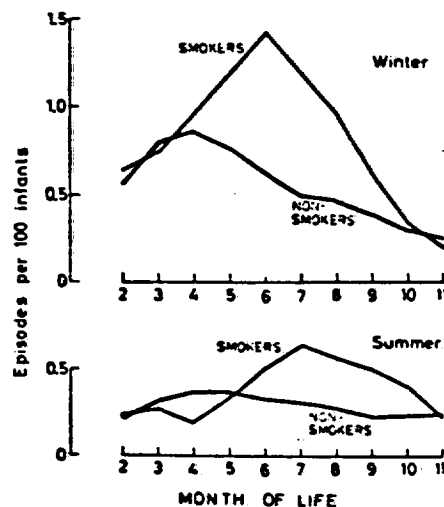
Two other important predictors of admission to hospital are social class, based on the husband's occupation, and birth order. In West Jerusalem, smoking mothers tend to be of higher social class, and,

independently of this, they have smaller families. Table IV shows that the effect of maternal smoking on rates of bronchitis or pneumonia was seen within each subgroup of social class. A similar effect was seen for birth order.

The excess of admissions for bronchitis or pneumonia in the group exposed to smoke was greater in the winter than in the summer (table V). For admissions in November to March, the rate in the exposed group was 46% higher than in the infants of non-smokers. For admissions in April to October, the excess was 24%. Of all the winter admissions for bronchitis and pneumonia, 4.2% were due to the effects of maternal smoking, compared to 2.4% of those in summer. Furthermore, for the rates of admissions for bronchitis and pneumonia attributable to smoking in the population as a whole, there was a threefold excess of winter over summer (0.26% compared to 0.08%), again a highly significant difference. These winter-summer differences are independent of small differences between smokers and non-smokers in the distribution of month of birth.

The excess risk associated with maternal smoking was not uniform throughout the first year of life (fig. 1). In the first 5 months of life there were no significant differences between infants born to smokers or non-smokers in rates of admissions for bronchitis or pneumonia. Between the 6th and 10th month, on the other hand, the rate in the exposed group rose to 1.46 episodes per 100 infants, compared to 0.46 in the winter. Toward the first birthday, differences between the two groups again disappeared.

The excess of admissions for injuries and poisoning in the infants of mothers who smoked was confined to first-born children (table VI). Although the numbers are small, the differences are most unlikely to be due to chance.



Episodes of bronchitis and pneumonia, winter and summer, in relation to maternal smoking.

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TABLE III—ADMISSION-RATES (PER 100 INFANTS) BY DIAGNOSIS, BIRTH-WEIGHT, AND MATERNAL SMOKING

Diagnosis	Birth-weight (g.)						Total (including unknown)	
	≤3999		3000-3499		≥3500+		S (986)	Non-S (9686)
	S (297)	Non-S (2326)	S (415)	Non-S (4098)	S (264)	Non-S (3195)		
Bronchitis and pneumonia	19.2	12.3	9.6	8.2	12.1	9.9	13.1	9.3
All other	22.6	19.9	14.3	14.6	15.2	13.3	16.9	13.5
Total	41.8	32.2	24.1	22.8	27.3	23.3	30.0	24.9

S=Smokers. Non-S=Non-smokers.

TABLE IV—ADMISSIONS (PER 100 INFANTS) BY DIAGNOSIS, SOCIAL CLASS, AND MATERNAL SMOKING

Diagnosis	Social class*						Total	
	High		Medium		Low		S (986)	Non-S (9686)
	S (392)	Non-S (2644)	S (327)	Non-S (3619)	S (267)	Non-S (3423)		
Bronchitis and pneumonia	6.6	3.9	15.6	9.0	19.3	14.3	13.1	9.3
All other	10.2	9.3	19.9	13.5	23.2	22.3	16.9	13.5
Total	16.8	13.2	35.5	22.5	42.7	36.6	30.0	24.9

* Ranked by husband's occupation.

TABLE V—ADMISSION-RATES (PER 100 INFANTS) IN WINTER (NOVEMBER-MARCH) AND SUMMER (APRIL-OCTOBER) BY DIAGNOSIS AND MATERNAL SMOKING

Diagnosis	Season	Smoking characteristics of mother			Relative risk (rate for smokers/ rate for non-smokers)	Admissions attrib- utable to smoking (% of total population)
		Non-S	S	Total		
Bronchitis and pneumonia	Winter	6.1	8.9	6.4 (P<0.001)	1.46	0.26
	Summer	3.3	4.2	3.4	1.27	0.08
All other	Winter	5.3	5.5	5.3	1.04	0.01
	Summer	10.2	11.4	10.3	1.12	0.11
Total	Winter	11.4	14.4	11.7 (P<0.01)	1.26	0.27
	Summer	13.5	15.6	13.7	1.16	0.19

Discussion

This study relies on information on maternal smoking which was collected antenatally. It is not known how closely smoking in early pregnancy or mid-pregnancy correlates with habits after the birth and in the baby's first year, but it seems reasonable to assume that for most mothers, smoking characteristics would have remained the same. However, there would inevitably have been some smoking mothers who subsequently gave up the habit, and others, especially former smokers, who took it up later. As a result, this study tends to underestimate true differences between infants of smokers and non-smokers, rather than the opposite.

An unexpected finding was the absence of a significant excess of upper-respiratory-tract infections in the group exposed to smoke. Since smoking causes pathological changes in the upper, as well as lower respiratory tract¹ and upper-respiratory-tract illness is increased in smokers,¹⁰ a measurable excess of upper-tract morbidity was predicted in the passively smoking infants. Hospital inpatient morbidity, however, is a poor indicator of the incidence of upper-respiratory-tract illness since most infants with colds, influenza, pharyngitis, and otitis media would not be admitted. There was a slight excess of hospital admissions in each group exposed to

smoke, not only for upper-respiratory-tract illness but also for gastroenteritis and other diagnoses. This excess, while not statistically significant, was observed consistently within the demographic subgroups, and may represent a small though subtle difference between smokers and non-smokers.

Another unexpected finding was the excess of injuries in the first-borns of smokers. A certain excess was predicted for all birth-order groups, since substances in tobacco smoke may reduce visual and hearing acuity among other indices of sensory and motor function.^{1,10} Smokers might, therefore, be more liable to accidents, but why the excess should be confined to first-born babies is not clear. In children under five years of age, proportions of injuries by birth orders will be due to child abuse,¹¹ rather than

TABLE VI—ADMISSION-RATES (PER 100 INFANTS) TO HOSPITAL FOR INJURIES AND POISONING, BY BIRTH ORDER AND MATERNAL SMOKING

Birth rank	Non-smokers	Smokers	Total
First-born	7	7	15
	0.3	2.2 (P<0.001)	0.5
Second or later born	31	3	34
	0.4	0.5 (N.S.)	0.4
Total	39	10	49
	0.4	1.0 (P<0.01)	0.5

to accidents, and in this context the interaction between birth order and smoking may be of interest.

This study provides convincing evidence that passive smoking increases acute lower-respiratory-tract disease, at least in infants. The results differ from those of previous studies of parental smoking and child health. Shy et al.¹² studying second-grade schoolchildren, found no relationship between respiratory illness and parental smoking. Cameron et al.¹³ on the other hand, did show an excess of acute respiratory illness in children exposed to smoke at home. The excess was only slight, however, in children under 5; it increased with increasing age, and may have been an effect of the children's smoking actively.

This study is consistent with material published recently by Colley et al.¹⁴ Reanalysis of their data shows a significant association between lower-respiratory-tract illness under the age of 2 and smoking at age 20. This association could be mediated through an effect of passive exposure to parents' cigarette smoke in early childhood, since smoking in young adults is correlated with parental smoking.

There is clearly a need for controlled studies in which objective indices of illness are related to measured levels of environmental pollution by cigarette smoke. Meanwhile, it would seem wise to discourage parents from smoking, if only for the sake of the health of their children.

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Requests for reprints should be addressed to S. H.

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IMPORTANCE OF WARM AND COLD ISCHAEMIA TIMES IN PRIMARY FAILURE OF HUMAN CADAVER KIDNEY TRANSPLANTS

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Summary A retrospective study was undertaken to determine the importance of warm and cold ischaemia times in the transplantation of a hundred and twelve human cadaver kidneys during a 5-year period in the Midlands. Cadaver kidneys with initial warm-ischaemia times of up to 60 minutes were transplanted successfully. Damage sustained during cold ischaemia was one of the major factors in causing the primary failure of a kidney transplant. Cold ischaemia of less than 450 minutes gave a primary-failure rate of 15%. However, when cold ischaemia exceeded 450 minutes the failure-rate increased to 41%. With the present system of ice-containing polystyrene containers used to transport and store kidneys for transplantation, a cold ischaemia of more than 7½ hours is inadvisable.

Introduction

ALTHOUGH ischaemic injury to the kidney during cadaveric renal transplantation is unavoidable, it is the aim of all transplant teams to minimise this injury. In the United Kingdom donor nephrectomy is usually carried out after circulatory arrest has occurred. Warm ischaemia is known to be especially damaging¹ and further ischaemic damage may occur whilst the kidneys are immersed in ice during transportation (cold-ischaemia damage), but the rate at which damage occurs during cold ischaemia is slower than during warm ischaemia.² Most British transplant units accept a cold-ischaemia time of as long as 20 hours if the warm-ischaemia time is short—less than 60 minutes. The failure of a transplanted kidney ever to secrete a significant quantity of urine is attributed usually to rejection during the oliguric phase, and the possibility that such a kidney may have been rendered non-viable by prolonged warm or cold ischaemia damage is often overlooked.

We have examined the effect of the various ischaemia-times on the fate of a hundred and twelve human cadaver-kidney transplants in an attempt to determine the time limits that are advisable.

Methods

Midlands Kidneys (62)

These were removed from donors using an en-bloc technique.^{3,4} The kidneys were separated, each bearing an aortic and a vena caval patch, and flushed through with

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